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BOSTON SOCIETY OF CIVIL ENGINEERS
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PAPERS AND DISCUSSIONS

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THE EARTHQUAKE RISK IN BOSTON

By Irving B. Crosby*

The existence of the earthquake risk is not generally recognized in this part of the country, nevertheless historic records[1] indicate that such risk should receive careful consideration, especially in large cities where no precautions are now taken to minimize damage by earthquakes.

The present common belief that Boston is immune from destructive earthquakes is unfounded. There have been severe shocks in Boston or its vicinity four times since the region was settled. From 1638 to 1870 approximately 208 earthquakes were recorded,[2] the period of greatest activity having been in the second and third quarters of the eighteenth century.

Historic Earthquakes

The first earthquake in the vicinity of Boston, of which we have a record, occurred on June 1, 1638.[3] It was recorded in Plymouth and was also felt in other parts of New England. The following account of the shock at Plymouth is taken from Bradford's History.[4]

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* Geologist, 9 Park Lane, Jamaica Plain, Massachusetts.

[1] Historical Notes of the Earthquakes of New England. W. T. Brigham, Memoirs of the Boston Society of Natural History. Vol. 2, 1871.

[2] There is no complete record of earthquakes in Boston since 1870. The area here included in the term "vicinity of Boston" extends from Newbury to Plymouth.

[3] All dates prior to 1752 are in old style, eleven days earlier.

[4] Bradford's History, p. 366. Edition of the Massachusetts Historical Society.

> This year (1638) aboute y^e^ 1. or 2. of June was a great & fearfull earthquake; it was in this place heard before it was felte. It came with a rumbling noyse, or low murmure like unto remoate thunder: it came from y^e^ norward, & pased southward. As y^e^ noyse aproched nerer, the earth begane to shake and came at length with that violence as caused platters, dishes, & such like things as stoode upon shelves, to clatter and fall down; yea persons were afraid of y^e^ houses them selves. . . . However it was very terrible for y^e^ time, and as y^e^ men were set talking in y^e^ house, some women & others were without y^e^ doors, and y^e^ earth shooke with y^t^ violence as they could not stand without catching hold of y^e^ posts and pails y^t^ stood next them; but y^e^ violence lasted not long. And about halfe an hower, or less, came another noyse & shaking, but nether so loud nor strong as y^e^ former, but quickly passed over and so it ceased. It was not only on y^e^ seacoast, but y^e^ Indeans felt it within land; and some ships that were upon y^e^ coast were shaken by it.

The fact that no mention is made of buildings being destroyed was probably due to the low, massive, cabin construction then used.

During the evening of January 26, 1663, a very severe earthquake occurred in the Province of Quebec where it did much damage and caused minor topographic changes. In Boston dishes fell from the shelves and the tops of chimneys were broken.

An earthquake occurred on the evening of October 29, 1727, which was felt with equal severity at Newbury and at Lynn. Houses shook and rocked as if about to fall to pieces. Pewter and china were thrown from the shelves. Stone fences, cellar walls and chimneys were shaken down; and it was difficult for men to stand up. A description of the earthquake taken from the church record of the Reverend Mathias Plant, minister at Newbury, follows:[1]

> Oct. 29, 1727, being the Lord's Day about forty minutes past ten the same evening, there came a great rumbling noise; but before the noise was heard, or shock perceived, our bricks upon the hearth rose up about three quarters of a foot; and seemed to fall down and loll the other way, which was in half a minute attended with the noise or burst. The tops of our chimneys, stone fences were thrown down; and in some places (in the lower grounds about three miles from my house) the earth opened and threw out some hundred loads of earth of a different color from that near the surface, . . . It continued roaring, bursting and shocking our houses all that night. Though the first was much the loudest and most terrible, yet eight more that came

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[1] Philosophical Transactions, No. 462, Vol. XLII, p. 33.

> that night were loud, and roared like a cannon at a distance. It continued roaring and bursting twelve times in a day and night until Thursday in the said week, and then was not so frequent.

From that time until 1741 Mr. Plant recorded approximately 120 shocks.

The greatest earthquake which Boston has yet experienced came at twelve minutes past four on the morning of November 18, 1755, only seventeen days after the famous Lisbon earthquake. The shock was felt from Chesapeake Bay to Nova Scotia, but appears to have been most severe just south of Boston. The shock and its effects were described by Professor John Winthrop.[1] Not less than 100 chimneys were levelled and at least 1,200 were shattered and partly thrown down. The roofs of some houses were quite broken in by the fall of chimneys; the gable ends of some brick buildings were thrown down and many were cracked. The vane upon the public market house was thrown down; the wooden spindle which supported it, about five inches in diameter, and which had withstood the most violent gusts of wind, being snapped off. Some bricks which fell from the top of a chimney, a height of 32 feet, were found 30 feet from the base of a perpendicular. On "made land" near the harbor the streets were almost covered by the bricks that had fallen. All through the country stone fences were thrown down, new springs were opened and old ones dried up. At Pembroke, Scituate and Lancaster in Massachusetts chasms were opened in the earth.

An account in Deane's History of Scituate, published in 1831,[2] makes it seem probable that the epicentre (place of origin) was southeast of Boston, possibly under the sea. The account follows:

> The great earthquake on the 18th of November, 1755, is well remembered by many of our aged people. They describe the violent agitation of the earth as continuing about fifteen minutes, in which time the walls were all thrown down, the tops of chimneys were broken off, and in many instances the whole chimney stacks were shaken down into the rooms, and many houses disjointed and nearly destroyed. The whole surface of the earth was seen to wave like the swellings of the sea, and occasionally breaking into fissures.

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[1] Philosophical Transactions, Vol. L (pt. 1, 1757) p. 1.

[2] History of Scituate, Mass. Samuel Deane, Boston, 1831, reprint 1899, p. 150. My attention was called to this by Professor J. B. Woodworth.

> It happened at day dawn in the morning and brought the people from their beds in dreadful consternation. The rumbling of the earth and the crashing of the falling walls was like the loudest thunder; and the commotion and roaring of the sea is described as no less terrible by those who lived near its margin. Several waterspouts bursted out in the town; we can name particularly, one near the brook at Sweet Swamp on the border of Deacon Joseph Bailey's garden. It threw out a considerable quantity of reddish earth of singular appearance, and the spring thus opened continues to run to the present time. Another fissure of considerable magnitude was made on the south side of "great swamp," so called.

The spring mentioned has been located and is now flowing. It is no longer used as a water supply but residents of Scituate remember going there for water and know that it was started by the earthquake of 1755. According to a report which is handed down in several families the earthquake caused a depression which is now occupied by a pond.

Earthquake Intensities

Earthquake intensities are commonly estimated by the Rossi-Forel Scale (when instrumental records are not available) which recognizes ten degrees of intensity. The scale is, however, not evenly graduated. A shock of intensity X is much more than ten times as strong as one of intensity I. The part of the scale here used is as follows:

X. Shock of extreme intensity: great disaster, buildings ruined, disturbance of the strata, fissures in the ground, rock falls from the mountains.

IX. Extremely strong shock: partial or total destruction of some buildings.

VIII. Very strong shock: fall of chimneys, cracks in walls of buildings.

VII. Strong shock: overthrow of movable objects; fall of plaster; ringing of church bells; general panic without damage to buildings.

The earthquake at Plymouth in 1638 is estimated to have been of intensity VII; that of 1663 of intensity VIII at Boston; the first shock of October 29, 1727, was probably of intensity VIII at Newbury, and the great earthquake of November 18, 1755, was of intensity IX at Boston. This last was probably of approximately the same intensity as the San Francisco Earthquake of 1906.

A study of the earthquake history of Boston shows that, although there were more severe earthquakes in the eighteenth century than there have been since, there was one of moderate strength (VI) in 1817 and there have been since that time several others only a little less severe.

Effects of Similar Shocks on Modern Construction

During the eighteenth century building construction was very different from that of today. Buildings were generally low, substantially constructed, and very few of them were on "made land." The method then used of pinning beams together enabled buildings to withstand severe vibratory motions.

Investigations at San Francisco[1] showed that well constructed wooden buildings were but slightly injured except for damage to chimneys and plaster. Wooden buildings poorly constructed, as many apartment houses are, were destroyed. Substantial stone and brick buildings, especially when well braced, withstood the shock, but poorly built stone and brick buildings were destroyed. Steel and reinforced concrete structures, when on suitable foundations, suffered little.

The writer believes that wooden and brick buildings of eighteenth century construction were better adapted to withstand earthquake shocks than many modern buildings of similar materials.

The San Francisco earthquake was much stronger than that at Messina, yet the latter caused a much greater loss of life. This surprising contrast was due to the very poor type of building construction at Messina and illustrates the great importance of suitable construction in regions where earthquakes may occur.

At present a large part of the densely built up section of the Boston district is on "made land," but during the eighteenth century most of the city was on natural land. The San Francisco investigations[2] showed that, other things being equal, the damage to buildings increased in proportion to the depth and incoherent qualities of the foundation soil. The destruction in San Francisco was confined largely to buildings located on alluvium or filled ground.

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[1] United States Geological Survey Bulletin 324, p. 133.

[2] United States Geological Survey Bulletin 324, p. 36.

Consideration of these facts leads to the conclusion that modern Boston would suffer relatively more than eighteenth century Boston did, if an earthquake equal in intensity to that of 1755 should again visit the city. Structures of steel and reinforced concrete and other strongly constructed buildings would probably be but slightly damaged, but a great number of flimsy brick and wooden buildings, especially on "made land," would certainly be destroyed, and the loss of life might be very great.

PROBABILITY OF FUTURE EARTHQUAKES

It is impossible to predict when the next severe earthquake will come, but there is no reason for believing that there will never be another destructive shock.

Professor Omori, Chairman of the Japanese Earthquake Commission, and other authorities, have stated that great earthquakes are followed by settled conditions in the earth's surface, and that there is an interval of 50 or 100 years during which no severe earthquakes occur.[1]

Destructive shocks occurred in 1638, 1663, 1727 and 1755. They were accompanied by others and they mark periods of seismic disturbance. It is now over 165 years since the last severe shock in Boston, and this has been a period of comparative quiet. But the study of other regions leads to the belief that this period of quiet will end, and that there will again be greater seismic activity. The date of this change cannot be predicted but every day brings it nearer.

Earthquakes cannot be avoided but the resultant damage can be greatly lessened by a wise choice of building location and the observance of such precautions in construction as an understanding of the geologic conditions would suggest to the engineer and architect. Therefore it seems very desirable that geology as it affects earthquake risks should be carefully considered.

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[1] United States Geological Survey Bulletin 324, p. 59.

The Foundation Conditions of Boston

The accompanying map is an attempt to show, in so far as is now possible, the foundation conditions of Boston as they affect the earthquake risk.

The important factors which must be known in estimating the earthquake risks of different localities are: depth to bedrock and the nature of the overlying materials. The map shows two sets of twenty-foot contours, one for the present surface (shown solid) and the other for the top of the bedrock, (shown broken).* The depth to bedrock at any point can be obtained by noting the difference between the surface and bedrock contours. A line indicating the old shore line is shown on the map and from this it is easy to determine which parts of Boston have been developed on "made land."

The materials overlying rock are of three general types: "made land," "waterlaid deposits" and "glacial till." The term "made land" is here used to designate land made by artificial filling in bodies of water. "Waterlaid deposits" comprise all deposits laid down in water whether of glacial or recent origin. "Till" is the unstratified material deposited by the ice sheet which once covered the region. It consists of boulders, pebbles, sand and clay, and is commonly called boulder clay or hardpan.

Drumlins are hills of till usually elliptical in plan with the axis lying northwest–southeast. They often have a rock core and therefore the depth to bedrock may be less than would otherwise be expected. Drumlins are very numerous in the vicinity of Boston.

The region about Boston Harbor and in the valleys of the Charles and Mystic Rivers, including most of the densely built-up districts, is underlain by clay and other waterlaid deposits except where there are drumlins. These extend down to bedrock and thus form islands of till surrounded by clay. On the higher ground clay is generally absent and till or rock forms the surface. In the district shown along the southwest border of the map, where the ground is high, there is little or no clay.

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* The bedrock contours are approximate and are of necessity much generalized. They are based principally upon data obtained from "Boston Foundations" by J. R. Worcester (*Journal of the Boston Society of Civil Engineers, Vol. 1, No. 1*), from the records of B. F. Smith and Company and from records gathered by W. O. Crosby. The surface contours were obtained from plans of the Boston City Planning Board.

Stability of the Different Materials

Experience in earthquake regions has proved that buildings with foundations on bedrock are the least liable to suffer damage in an earthquake, unless the building is on or very near the "fault" which was the cause of the shock. Dry unconsolidated material, but compacted like till, is next to rock in order of desirability as a foundation in earthquake regions. Unconsolidated material saturated with water comes next and "made land," especially if the material is fine and saturated with water, is the most unstable.

The instability of all unconsolidated materials is greatly increased if there is an unsupported edge towards which the material can move.

Comparative Stability of Different Localities

Since damage to buildings from earthquakes increases in proportion to the thickness and incoherent qualities of the foundation soil, it follows, that if two localities of similar foundation materials are being compared the degrees of stability will be in inverse proportion to the depths to rock. If the formations of the two places differ, the case is not so simple and no rule has been worked out; nevertheless, from the information available a fair idea of the stability of any locality may be obtained. A depth of 50 feet in clay would probably be worse than 100 feet in till.

The South Cove, Back Bay and Allston districts, and that part of Cambridge near the river, present the worst conditions. The depth to bedrock is great, in places 200 feet; the natural deposits are generally clay and much of the land was made by filling. The banks of the Charles River and of the harbor are unsupported edges toward which the material can move.

The area of the old city proper presents better foundation conditions as the depth to bedrock is less and a considerable part of the area is on drumlins. The conditions in Charlestown and South Boston are similar.

In East Boston the depth to rock is great, in places 200 feet, and those parts are underlain by clay. The resulting foundation conditions are similar to those in the Back Bay. Part of East Boston lies on drumlins and there the foundations are better but not so good as on the drumlins of Boston because in East Boston the depth to rock is greater.

Wherever deep rock valleys are indicated on the map foundation conditions are unsatisfactory with regard to stability in earthquakes. In the Charles and Mystic River Valleys the depths to rock are great; the overlying material is largely clay, and the same conditions apply to a buried rock valley which extends from the Mystic Lakes by Fresh Pond thence through Allston and the Back Bay to the old harbor south of South Boston. This valley was occupied by the Merrimack River in preglacial times.

On the higher parts of Dorchester, Roxbury, West Roxbury, Hyde Park and Brookline, and also on the high land north of the Boston Basin, the depth to rock is generally moderate, in places ledge is at the surface, and the overlying material, where there is any, is largely till. These areas, some of which are outside of the limits of the map, present generally the best foundation conditions.

In the remainder of the Boston Basin, except where there are drumlins, the unconsolidated material is largely waterlaid, and the depths to bedrock are generally moderate. The foundation conditions average better than for the business districts but are not so good as in the regions where till and ledges predominate.

Summary

Boston has undergone four severe earthquakes and considerable damage was done in one of them. There is no reason for believing that a severe shock may not again visit the city.

Much modern construction is not so well adapted to withstand earthquake shock as that of the eighteenth century and a similar shock today would probably cause far greater damage, especially since large sections of the city are now on "made land" which adds greatly to the earthquake risk.

Damage by earthquakes is proportional to the depth and incoherent qualities of the foundation soil. The first of these factors (the depth to bedrock) is shown on the accompanying map. The comparative stability of the different materials is, beginning with the most stable: rock, general mantle of till, drumlins, waterlaid deposits and "made land."

The business districts in general have unsatisfactory foundation conditions, as far as the earthquake risk is concerned, but in most of the suburban districts the conditions are more favorable.

In brief, the earthquake risk in Boston calls for careful consideration in the future development of the city if a disaster such as occurred in San Francisco and recently in Japan is to be avoided.

EDITOR'S NOTE

The members of the Committee on Subsoils of Boston have been much interested in the preparation of this paper by Mr. Crosby, particularly with reference to the probable bedrock contours shown on the map, and have assisted him in securing some of the data.

Both the author and the Subsoil Committee will appreciate a discussion of the subject of rock foundations in Boston, and members are urged to send to the Secretary of the Society any information they may have either corroborating or disproving the rock contours as shown on this map.

It is realized that more information may alter these contours to some extent, and these additional facts will make possible the preparation of a revised map at a later date which will include all the reliable data.

As stated in the Progress Report, presented at the Annual Meeting on March 21, 1923 (*Journal of the Boston Society of Civil Engineers, April, 1923*), the Subsoil Committee is continuing the extensive work of Mr. J. R. Worcester of collecting, classifying and correlating data relative to soil and foundation conditions, and it is expected that this data will soon be available for reference in the rooms of the Affiliated Technical Societies of Boston.

ENGINEERING AND CONSTRUCTION EXPERIENCES

By Chas. T. Main, J. Parker Snow, William F. Williams, William H. Sayward and James W. Rollins

(Presented October 17, 1923.)

Chas. T. Main*

We have been asked to give some reminiscenses of some things of interest that have impressed us. In order to do this, it is necessary to be more personal than one would ordinarily desire to be.

One of the things I think back to occasionally is the time when I was engineer at the Lower Pacific Mills in Lawrence, during which period we built several new buildings and remodelled some others, remodelled the water power plant, put in a new steam power plant, and remodelled the driving system, all of which involved a large expenditure, much study and many plans. Those were the days when a mill could be built for 60 to 70 cents for a square foot of floor space, for regular mill construction and for buildings as good as we now construct for about $2.50 a square foot.

The engineering department consisted of myself and a carpenter to hold the tape and leveling rod. This engineering department made the plans, laid out the work, and did the inspection of the construction. The cost of engineering was not over 1% of the cost of the work. It, however, took more than eight hours a day.

I have often wondered recently how it was possible for the department to make a complete set of plans for a good-sized mill in two or three weeks, and why now, with a similar job it takes several men a month. Is it because we have gone from a very simple system or method of doing work to a more complicated one? Our plans were complete, but we did not make quite so many details. We assumed that the contractor knew something when we used one, and that the workmen knew their trade better than now. Most of the work, however, was done on force account by our own organization.

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* Engineer, 200 Devonshire Street, Boston, Mass.

The specifications were brief, but explained sufficiently what was to be done, and how it should be done with few words.

When we had a contract it was usually in the form of a letter which was as binding as the most voluminous document, some of which now seem to be written so that they cannot be understood.

The amount of paper work then indulged in was small, perhaps because it all had to be done long hand. I recall one contractor, at a somewhat later date, when I was in Boston, who did a large amount of work for us, who never wrote a letter, but always took the train to Boston for a personal interview.

In 1886 I delivered a series of lectures at the Massachusetts Institute of Technology on Mill Construction. That was the year after we had about completed our plan of reorganization. I was then quite a mature engineer, about thirty years old. In 1909 my son graduated from Tech and I found while he was there that these lectures were used as a textbook. I have been trying ever since to revise them, but have not had the necessary time. Fundamentally there has been no change since 1886 in regular mill construction. There have been changes in detail, and some features added, but not in principle. If, then, there has been no change in fundamentals, why should there be so much difference in effort, time, and expense of preparation of plans and specifications?

There are a few more complications than formerly, and we use more words and figures than formerly, and words and figures, when put down on paper, cost time and money, but these alone cannot account for the difference.

During this period of time, advances have been made in the design and construction of some classes of machinery, so that the product turned out per operative has been increased, but all work done by hand, without the aid of machine tools, has decreased in recent years, per hand per day, at the same time with increasing wages and shorter hours. This is not confined to the so-called laboring man, but applies to nearly every class of workers. Is it because we do not want to or do not need to work so much, or want to play more, or is it partially a loss of interest and pleasure in accomplishing something worth while at a reasonable cost?

One of the things which cause me considerable anxiety in my business is the making out of bills. They seem so horribly big that I am frequently shocked and frequently make the bill with diminished or no profit in order not to charge more than the service is worth. Perhaps this is one of the misfortunes of being able to look back.

Recently we had a job very similar to one we had between fifteen and twenty years ago. I was interested in a comparison of the cost for Engineering Services and found that now the cost is 3 to 3½ times what it was then. This has been brought about by the following factors: Daily wages have doubled, while the working hours have been decreased; holidays and vacations are paid for.

"Slip," that is the time used up in gossip, washing up, lighting pipes, glancing at papers, is at least, no less in time than it used to be, and is, therefore, a greater per cent of the time in the office.

Overhead has doubled or trebled as in almost every branch of work, owing to the more complicated system in use, increase in rents per square foot of floor space, and increase in cost of materials.

Combining these increases accounts for a large proportion of the total increase, but not the whole of it. The remainder is due to a combination of three things. As an organization increases in size, there is less touch between the head and the subordinates, and more time and effort required in transmitting ideas and recording them than by direct action, more work is done for the same kind of a job, and less work is accomplished per hour by each man.

Is there any remedy?

I am at a loss to see how we can get down from the higher plane. It cannot be done by organization, resolutions, or laws. It can only be done by individual effort to produce a reasonable return for the money expended. I am sorry to say that for many people this seems foolish, their slogan being, "Get all you can for as little as possible." And until the folly of this filters through their minds, we must remain on a higher plane of costs.

Now, on a wholly different subject.

When I was in Lawrence, in the 80's, there was a lawsuit to determine the value of some water power, which had been diverted from a mill in the Spicket River; and I was called in as an expert. I listened to the testimony and wondered what I would say when called. Fortunately, the case was settled before I was reached.

I vowed that I would not go into court again on a water case without some idea of what it was all about, and so began to investigate the subject, but could not find any printed matter.

I did find, however, that it was customary for the person representing the plaintiff, at least, to say that the value of a water power was represented by a sum of money, which, when put at interest, would maintain and run a steam plant of the same power at the same place.

At first glance, this reasoning may appear to be sound, but upon examination it will be seen to have no foundation, as there is no set of conditions under which it holds good. I set about preparing a paper on the subject and got along well until I reached a set of conditions where the cost of water power and supplementary steam power was more than the cost of steam power alone. In which case, the privilege is worth less than zero. This was heresy. I also could not determine how much less than zero the value might be. I threw the paper into the desk where it remained several months, and one night I thought of the answer and finished the paper, and presented it to the A. S. M. E. in December, 1891.

The fundamental correctness of the method therein set up has not been seriously disputed. I have studied the subject many years, and have estimated values of water power for purchase and sale, condemnation, taxation, etc., and the longer I study it, the less I think I know about it, and the more I feel that my method is *one* logical way of approaching the problem and produces a result which will help considerably in the determination of the value, but that it may not give the final answer as there are human and business elements of uncertainty entering into nearly every problem of this sort.

One morning, after many days of hearings in some water cases, I walked to the Court House with the Chairman of the commission, and he remarked that "That damned engineer member of our committee thinks he can figure this thing out mathematically. No living man can."

Also, I have never forgotten one thing which Professor Howison, Professor of Logic at Tech, told us, and it is the only thing I remember he said. He said, "We are reasonably sure of some things but not positively sure of anything."

Here is the difficulty. The engineer can figure accurately from the laws of nature, the results of certain actions, like water falling through a given distance, but when these results become mingled with the laws and vagaries of man, the mathematical results, while correct, may not tell the whole story.

As I grow older, I have become more tolerant toward the other man's opinion, who, starting with the same premises, has arrived at an answer apparently the direct opposite of my own.

Engineering may be an exact science by itself, but when it becomes involved in business and the human elements, it is exact only so far as it deals with fixed principles. Beyond that, when it enters into speculative conditions and values, it is not exact.

The engineer is fitted to guide up to a certain point. Beyond that, if he has had no business or commercial training, and has no imagination, he finds his limitations.

In 1891 I was quite positive of my premises and the answer. Since that time there have been so many changes in conditions, and since 1914 so great an uncertainty as to real values, I have not been sure that the mathematical results represented real commercial or market values. I am quite sure that up to a certain point the Engineer is nearer right than any one else, or, at least, has a logical basis for his reasoning, and that my method is one that indicates the value within certain limits, but I also feel that there may be other methods of determining the value which should be recognized.

Back in the 80's, there were suits for abatement of taxes, as at present. We based our values on the cost of reproduction less depreciation and on sales of similar property. There was then no reason for comparison of conditions in the South or elsewhere. Lawrence and Lowell were as good places for manufacturing as any.

We made valuations for other purposes on the same basis without any thought that they were not approximately correct.

These conditions held good until 1914. Since then we have made many valuations, based on existing costs for definite dates, and depreciated for wear and tear and obsolescence; but who could positively say that these represented fair cash value, when we must consider competition of mills built prior to 1914, the possible decrease in cost of buildings and machinery from present prices, and competition from plants located where conditions are more favorable for conducting a particular business?

The engineer can make reasonably correct figures on certain assumed existing conditions and prices in a certain place and a certain time, but if he is to determine fair market value, he must go beyond his technical skill and knowledge, and get into the speculative side of the values of properties.

The point I am trying to make is this, that, in the latter part of the last century, some of us at least were fairly sure that our answers were correct. Today we must broaden our vision to include the human and business side of Engineering, and be more tolerant towards the other fellow who may not agree with us.

J. Parker Snow*

We are supposed this evening to give some details of our past experience. I am going to give you the details of a dream. It has to do with the railroad situation in New England and as yet, nothing but the dream has achieved a past.

It seems to me Nature has fixed the topography in our vicinity so that it would be possible to make Boston the best railroad center and the best ocean shipping port that there is on the Atlantic Coast of the United States. The industrial nature of the hinterland, our geographical location with reference to northern Europe, our island studded harbor, the climate, our wealth and other considerations would seem to strengthen this assertion. The waters of our harbor occupy about a quarter of a circle, with the city proper at the center of the circle, and the ocean shipping facilities naturally are built on the sides of the harbor, where there is unlimited chance for extension as shown by Mr. Desmond FitzGerald in his report on "Docks for Boston" 1908, leaving the old water front from Fort Point Channel to Charles River for ferries, harbor boats and small coastwise steamers, which must have a landing near the business center. Our congested business section, the nucleus of the city, is at the apex of this V, and the railroads are so situated that they can pass down by the congested center along the sides of the harbor, without interfering at all with the business area. The other three-quarters of the circle is land unobstructed by an almost unbridgeable river as occurs in many cities of the country, both inland and coastwise, so that all of the land practically can be used for expansion of industries and residential areas. A good many of our large cities have the business portion hemmed in by rivers or great railroads. That is so in New York with rivers, and at Chicago with a band of railroads around what is called the "loop district." They have no chance to expand. Boston is favorably situated in that respect.

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The remaining three-quarters of the circle — the land area — is well covered with radial lines of railroads, and if New England cannot furnish business enough to satisfy the size of our city and our ocean shipping facilities, and we look to the West for business, we find that there is a natural highway across the Appalachian chain of mountains right opposite our city. It is in a direct line between our city and the Great Lakes region, which commands the Great Northwest. This gap across the Appalachian Mountains is, of course, the Mohawk Valley. The summit of this pass is some 75 feet *below* the level of Lake Erie. That means that there is no hill against eastbound traffic coming our way until we get to the Hudson River. At the mouth of this valley at the Hudson River, we are about equally distant from Boston and New York City, but the line down the river to New York is level, whereas coming to Boston two mountain ranges must be crossed.

Now if the cost of transferring traffic between railroads and vessels can be made enough less here than at New York to balance the difference in cost of haul between the Mohawk Valley and the two ports, Boston is bound to secure enough ocean shipping to make it an important outlet in comparison with New York. It seems to me that it can be done. Terminal charges at New York are something tremendous. One good authority says it costs as much, or more, to transfer a parcel of freight from a point only 60 ft. back from the New York water front to the vessel, as it does to ship it on the vessel from New York to South America. Other things make transfer business very expensive at New York, so that if that work can be done here at Boston cheap enough to pay for lifting the traffic over the two ranges of hills, Boston is bound to get its fair share of western business; because the business will go where it can be done the cheapest, irrespective of who owns the traffic line.

In order to accomplish this it is absolutely necessary that the terminal business of the railroad be done under one control. At present, as you know, there are three owners of the property used in this work, — the New Haven, the Boston & Albany, and the Boston & Maine. There are various ways that this control can be unified, — first, perhaps by a single ownership of the property involved, under one independent ownership as a railroad system; second, as an operating division of some great system which owns outlying railroads as well as the terminal property; and third, perhaps by agreement among the present owners. But it is necessary that there be control and operation under *one* head.

A second prime essential of a successful terminal is a belt line railroad. In the past many schemes for belt lines have been suggested, any one of which would cost a tremendous amount of money and none of which if built would have done the work the way it should be done. Any scheme considered must avoid the expenditure of large sums of money, because we have now more money invested in our railroads than we can earn a fair return on. It would be simply suicidal to put in a large amount of new money. Moreover, the revenue possible, if the control is unified, would be but very little more than it is now. The advantage will accrue instead to the industries and business men in this vicinity. It is very doubtful, however, whether the public would come forward and shoulder any expense. It is a curiosity of our psychology that the public will spend large sums of money for dredging harbors or rivers, building piers, warehouses, etc., for water transportation; build toll-free canals; expend large sums of money for highways for any sort of traffic; while they require a steam railroad to pay for everything it needs, even for the major part of the elimination of grade crossings, in which the public is a factor as much as the railroad. That is a curious thing, but it is a fact nevertheless, and it is very doubtful if any part of the expense of establishing a terminal system here would be borne by the public.

We have a line of railroad already built that is almost an ideal belt line, but it never has been coupled up to work as such. I refer to the Grand Junction Railroad, starting from East Boston, swinging around through the terminal freight yard of the Boston & Maine, and continuing to the freight terminal of the Boston & Albany at Allston. Then I would use the main line of the Boston & Albany to Riverside Station where the line should turn to the south to Newton Highlands, where it would need a Y connection to the New Haven lines, going to Needham Heights and Needham, thence to West Roxbury where another Y connection would take it to Dedham, and then to Readville, or perhaps by the loop to Islington, then by the main line of the New Haven to South Bay and on to the South Boston Piers. That is a pretty nearly ideal belt line. It would be about forty miles long, making the round trip just about right for a day's work of a train crew. The line needs a second track in several sections and the two Y connections above mentioned, but the cost of these would be far less in my opinion than the cost of buying a right-of-way and building a single mile of any other belt line which has been proposed. Moreover it is much better conditioned to do the work properly.

A belt line should fulfill three important functions. First, it must connect up with all of the radial lines coming into Boston, which this would do, by passing through the terminal freight yards of all three of the railroads. Second, the communication between the ocean shipping facilities and this belt line must be convenient, and that is the case with the line proposed. The East Boston piers are served by it, the Mystic wharves, the Hoosac Tunnel docks, and the Navy Yard are handy to it. The South Boston facilities are convenient at the other end of the line.

Third, a very important function of the belt line is that it should serve and pass through the industrial zone which generally builds up around a city just outside the old residential area. The line proposed serves East Boston and passes through the industrial district at East Everett, convenient to the Everett marshes where there is unlimited area for expansion; then after leaving the Boston & Maine territory it passes through the rapidly growing industries in East Cambridge and Cambridgeport; then at Riverside Station it is convenient to the Newton Lower Falls industries and those at Newton Upper Falls; passing on to Newton Highlands and to Needham; then through the unoccupied area well adapted to industrial development, between Needham and West Roxbury; then through Dedham and the river flats along Mother Brook and the Neponset River flats, which would naturally develop with industries if the section could be served as this line would serve it, with as many trains each way per day as might be needed to bring and take away cars. This line seems to me practically ideal and it is almost all built.

If it should be deemed advantageous at some time to cut out the section through Cambridgeport it would be quite easy for this line to follow the main line of the Fitchburg Division out just beyond Waltham and then swing around to Riverside with a mile or a mile and a quarter of new line. But the line through Cambridgeport cannot be abandoned unless Cambridge is willing to give up her industries and I don't think this will happen very soon.

I haven't said anything about passenger facilities because I think we are pretty well off as we are. Very few passengers on the trains care to go through Boston. There are a few perhaps in summer who wish to go through, but generally trains are made up from Worcester and go thence through Nashua to the North Shore resorts, rather than through Boston. In my opinion it would cost a great deal more to unify the passenger service, to get it all through one station, than it is worth. I don't believe it would begin to pay.

As I have stated, there are several ways of consolidating the ownership control, but the worst detail to be worked out if the ownership of the terminal property is separated from the outlying railroads, would be to determine a fair portion of the rate, either passenger or freight, which should belong to the terminal system. There is a scientific way to do it, but we don't make our rates in this country on a scientific basis. It is done in other countries, but not here.

There are scores of details which can't be gone into here. I am not going to say much about the consolidation feature, which is so prominently before the railroad world at the present time, except to say that in my opinion there is no rational place to stop in consolidation until every mile of railroad in the United States is under one ownership corporation. I don't mean by that Government ownership, by any means. I think one corporation can handle all the railroads in the country, if properly organized. And, if properly organized, there would be less of absentee management, I believe, under a single ownership, than there is at the present time.

This in outline is the dream; it remains to be seen if the business interests of Boston will put it across.

William F. Williams*

I presume that you would not be interested in all the troubles that I might tell you about that have taken place in my experience as an engineer, although I hope that I have secured some benefit out of them. But it seems to me that the really interesting thing to you, if I can make it so, would be for me to resolve what little I have to say into a short discussion of what I have found to be the fundamental cause or source of the most serious troubles that I have encountered in my work as an engineer. Engineers are intimately concerned with the construction of all sorts of structures, and the first essential of good construction is a sound foundation. In the creation of a sound foundation, the engineer encounters many difficulties. There is ledge, which to some engineers is troublesome, although I cannot say that I have ever felt that way about it. But there is one difficulty we all have to contend with at some time which to my mind is the most serious of them all, and that is water.

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* Commissioner, Department of Public Works, State House, Boston, Mass.

In selecting a wet subject I hope I may avoid becoming dry, and I say this without any reflection upon the antidote provided by the committee. This reminds me that once I was describing the construction of the foundations of the piers of a bridge before an audience of which very few were engineers, and I elaborated in some detail upon the success we had had in the construction of an open cofferdam which we had succeeded in making very dry. To make this point clear, I made the statement several times "That it was a very *dry* dam." After I got through a friend of mine said, "Williams, why did you want to emphasize the fact that it was a dry dam. I was ready to agree with you on your first statement that the subject was unusually dry."

Mr. Main has referred to the growing length of specifications, and I suppose it is especially true of the contracts made by the Commonwealth. I think the State is very careful to avoid leaving any loopholes that may react against the Commonwealth, although they may react against the contractor. At the same time I believe it is well for all engineers to have in mind when drawing specifications and making plans, that they are the only information that the contractor has as to what the engineer has in his mind, and if he cannot so draw his specifications and his plans that they will convey to the contractor exactly what he is trying to build he may anticipate a great deal of trouble. If every engineer before putting out specifications and plans to contractors for bids would ask himself if he could build the proposed structure with the information they furnish, I think contractors would have less cause for complaint.

In the preparation of specifications for work that is involved with water it is, of course, particularly important that the engineer should know all that can be learned of the character of the bottom or soil, on which he intends to build. The wash boring is the convenient and usual method of examining this material and yet it requires almost the experience of a lifetime to understand a wash boring. I recall that my first encounter to any considerable extent, with wash borings as a means of providing accurate information as to the character of the material in the proposed foundations was in connection with the erection of a sewage pumping station on the edge of tidewater. The bottom of this station, which was for pumping sewage, was to extend some 15 ft. below high tide which, with an extreme range of tide of about 4 ft., meant that the bottom might be under a head at times of 19 ft. I had this area very carefully explored with wash borings, and was very much pleased that every one apparently bottomed on ledge. But notwithstanding that I believed I was sure of a substantial foundation, I made rather careful preparations by providing heavy sheeting and excavating a sump for a capable pump. As the excavation proceeded a boulder was found at the bottom of the first boring. That was rather unfortunate but the next boring developed another boulder, and so it went until all of our borings which we thought were on ledge proved to be on boulders, and we found no ledge whatever in the entire excavation. It so happened, however, that we did run into rather dense material and were able to complete the work without much trouble with water and secured a very dry chamber.

In dealing with water I have found a singular objection amongst a good many engineers to placing concrete in water. I have had a number of cases where I could do nothing else. In fact, early in my experience, the question arose as to how I should deposit concrete under water. At the time I was building the Fairhaven Bridge, and the center pier of the draw span was in water that was to be about 30 ft. deep at high water. The bottom was soft for several feet and then sand and gravel to hardpan or ledge about 60 ft. below high water, therefore it was decided to drive piles as the weight of the draw was 1,000 tons. The soft material was removed by dredging and after driving a cofferdam of heavy sheeting the piles were driven about 3 ft. on centers both ways. It was then decided to place concrete around the piles and the next question was how to deposit this concrete under water. I knew of the use of the tremie which was the most common device in use at that time for this purpose, but I feared that moving the tremie around amongst the piles would result in endless losses of the charge of concrete. To meet the situation, the contractor built a cylindrical bucket of boiler plate about 2 ft. in diameter, and 6 ft. in height, slightly larger at the bottom than at the top. The bottom was hinged so as to open down when the latch was released by a tripping line. The bucket was filled with concrete and lowered through the water to the bottom when the charge was released by opening the latch.

Several years afterwards I had occasion in the construction of the State pier at New Bedford to again have a situation requiring the placing of a large amount of concrete in the water. The walls of the pier are carried on a pile platform, but to protect the face of the platform and front row of piles from the teredo and also to retain the fill I designed a concrete curtain wall enclosing the outside row of piles, of the sides and end of the pier. After trying a tremie, the contractor purchased the buckets used on the bridge and deposited the concrete in the water to the height of the platform at mean low water. From that point up the wall was built in the dry.

Some years later one of these cylindrical buckets was again brought into use for placing concrete in the foundation of the pier of a bridge built over Charles River in the towns of Dover and Needham, after an ineffectual attempt to build a sand bag dam around this pier in some 7 ft. of water.

In connection with the construction of the sewage pumping station, it became desirable to avoid joints in the concrete walls of the pump chamber to prevent leakage. It was found that the quantity of concrete in the walls and floor was much larger than the contractor could place within 8 hours, and it was not considered advisable to work nights. Therefore the floor was laid in one operation and the walls were divided into sections with the joints vertical, except where they joined the floor. Sheet zinc was then folded so as to make a V shaped fold in the middle with about 6 inches of the plate projecting on each side which were embedded in the concrete on each side of the joint with the V fold between. This prevented any leakage or even seepage of water through the joint and also left a little latitude for expansion and contraction. I have since seen this same device worked out on a heavier scale, but we succeeded in getting a water tight chamber.

It is strange how many contractors, especially those who are building their first bridge or some structure that involves a contest with water, fail to realize the necessity for going at the water job in a safe, sure way. Many times they want to use 2-inch plank, not jointed or tongued and grooved, when it would be much better and in the end less expensive to use heavier plank and heavy wales and braces. As a result they encumber themselves with a cofferdam that it is impossible to pump dry and are put to great expense to overcome a situation brought about upon themselves by underestimating the difficulty of working in water.

Overpumping when placing concrete is a serious thing, and I would much rather place concrete in still water than in a dam where the water is being pumped out in any volume. I recently had occasion to visit a bridge under construction where the contractor, misjudging the situation, had built a very frail and insufficient cofferdam and was trying to pump the whole river through it. Naturally he was seriously disturbed over the problem as he was confronted with an almost impossible situation unless he should decide to rebuild the cofferdam. Fortunately for him there was an easy and safe way out of his trouble which was to let the cofferdam fill up with water and then place about one foot of concrete in the water which would seal the bottom and he could then pump out the dam and place the balance of the concrete in the dry. He did so and had no further trouble.

Now, of course, this is like "carrying coal to Newcastle" to tell you gentlemen my troubles when you have had others of your own that may have been much more important, but I have one other experience where water entered into my troubles that may interest you. I was consulting engineer on the construction of a deep sewer that had an average depth of about twenty-four feet below the surface of the street with a heavy retaining wall and fill on one side, and buildings on the other. The soil was a very fine sand mixed with silt and full of water, but in this case it was not possible under the terms of the contract to place concrete in the water because it was a reinforced concrete pipe sewer. Therefore, after developing many unknown difficulties with other sewers, it finally became necessary to timber the trench almost as heavily as though it were a shaft and all the timber was left in place to avoid settlement of the adjoining buildings.

While engineers and contractors have many troubles to contend with I have come to look with a great deal of respect upon water and my respect increases with the head.

William H. Sayward*

Mr. William H. Sayward, immediately upon introduction, disclaimed any intention of speaking on the subject announced for the meeting — "the trials, tribulations and triumphs of the engineer" — owing to the fact that his profession was not that of engineering. His fifty-four years of service as Secretary of the Master Builders Association of Boston have, however, brought him in close contact with builders and contractors many of whom are engineers and members of the Boston Society of Civil Engineers.

After speaking in a humorous vein, and telling many interesting anecdotes (all of which the editor was forbidden by Mr. Sayward to publish owing to his belief that they were too frivolous for an engineering journal), he told in a serious way of his work, aims and accomplishments in the many years that he has guided the affairs of the Master Builders Association. He announced that an article on Education, which he had prepared, would be sent to the members of the Society in the near future.

In closing he read an article from *The Associated Contractor*, headed "Ways to Kill an Association," containing thirty-two rules and precepts. This article we take the liberty of printing.

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* Secretary and Treasurer, The Master Builders Association of Boston, 77 Summer Street, Boston, Mass.

Ways to Kill an Association

1. Don't come to the meetings.

2. But if you do come, come late.

3. If the weather doesn't suit you, don't think of coming.

4. If you do attend a meeting, find fault with the work of the officers and other members.

5. Never accept an office, as it is easier to criticize than to do things.

6. Nevertheless, get sore if you are not appointed on a committee, but if you are, do not attend committee meetings.

7. If asked by the chairman to give your opinion regarding some important matter, tell him you have nothing to say. After the meeting tell everyone how things ought to be done.

8. Do nothing more than is absolutely necessary; but when other members roll up their sleeves and willingly, unselfishly use their ability to help matters along, howl that the association is run by a clique.

9. Hold back your dues as long as possible, or don't pay at all.

10. Don't bother about getting new members. Let the secretary do it.

11. When a banquet is given, tell everybody money is being wasted on blow-outs which make a big noise and accomplish nothing.

12. When no banquets are given say the association is dead and needs a can tied to it.

13. Don't ask for a banquet ticket until all are sold.

14. Then swear you've been cheated out of yours.

15. If you do get a ticket, don't pay for it.

16. If asked to sit at the speaker's table, modestly refuse.

17. If you are not asked, resign from the association.

18. If you don't receive a bill for your dues, don't pay.

19. If you receive a bill after you've paid, resign from the association.

20. Don't tell the association how it can help you; but if it doesn't help you, resign.

21. If you receive service without joining, don't think of joining.

22. If the association doesn't correct abuses in your neighbor's business, howl that nothing is done.

23. If it calls attention to abuses in your own, resign from the association.

24. Keep your eye open for something wrong and when you find it, resign.

25. At every opportunity threaten to resign and then get your friends to resign.

26. When you attend a meeting, vote to do something and then go home and do the opposite.

27. Agree to everything said at the meeting and disagree with it outside.

28. When asked for information, don't give it.

29. Cuss the association for the incompleteness of its information.

30. Get all the association gives you but don't give it anything except h——.

31. Talk co-operation for the other fellow with you; but never cooperate with him.

32. When everything else fails, cuss the secretary.

JAMES W. ROLLINS*

The last speaker of the evening was Mr. James W. Rollins, for whom the twenty minute time limit had been extended, owing to his naïve suggestion that those who were tired could readily slip out under cover of the darkness attending the presentation of his lantern slides.

Mr. Rollins opened his address with a most interesting account of the difficult foundations for the Piscataqua Bridge at Portsmouth, N. H., which were successfully completed by his firm in March, 1922. The method of carrying out the construction was well illustrated by slides, showing each step of the work. This project was attended with great difficulties owing to the tremendous force of the tide as it ebbed and flowed through the narrow channel of the river, and the greatest problem was that of moorings and anchors for the caissons.

(Mr. Rollins presented a detailed account of this work at the Portsmouth Convention of the American Society of Civil Engineers in June, 1922, which may be found on pages 443–446, Vol. LXXXVI, 1923, *Transactions of the American Society of Civil Engineers*.)

Following his description of the Piscataqua River job, Mr. Rollins related many of his experiences as a railroad engineer, some from his early career as chief engineer during the construction of a branch line railroad across the cranberry bogs of Cape Cod, and others when he was engaged in location surveys for the Union Pacific Railroad in the Rocky Mountains. In conclusion he told several incidents, some comic — some tragic, which he had experienced in his career as a contractor on difficult and large scale construction jobs.

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ACTIVITIES OF THE FEDERATED AMERICAN ENGINEERING SOCIETIES

Engineers' Place in the Preparedness Program

It will be recalled that during the World War the engineers assisted in the work of industrial mobilization through sub-committees of engineers in practically every State of the Union. They developed the great Inventory of 1916 which assisted in showing such organizations as the War Industries Board; the Price Control Committee; the Food, Fuel, Railroad and Communication Administrations; the War Finance Corporation and the War Trade Board, what the capacity of the country was in practically every line of endeavor. In addition to this war time service of the engineers, the American Society of Mechanical Engineers and the American Institute of Mining and Metallurgical Engineers now have committees which are extremely active and helpful to the War Department in its plans for industrial mobilization. During recent conferences of L. W. Wallace, Executive Secretary of the Federated American Engineering Societies, with the Assistant Secretary of War, this matter was brought forward as one of the ways in which the engineers could render a great public service in the opinion of Assistant Secretary Davis. At the proper time he will undoubtedly arrange to set forth his ideas for use of the entire engineering fraternity in this great work. The retiring Assistant Secretary of War said during a lecture to the Army War College last January:

> It is inconceivable with our vast resources in material combined with the ingenuity and intelligence of our people, that America should ever be defeated in war. You are all familiar with the military maxim that "It is pardonable to be defeated but never to be surprised." We were surprised in the matter of industrial preparedness for the World War. We must plan so that those errors will not be repeated.

To the Assistant Secretary of War falls the task of planning for industrial mobilization, and under the law the procurement division for the entire army is placed under his supervision.

This is divided into two parts, one of which is concerned with current procurement and the other with war supply planning. The Assistant Secretary of War is therefore primarily concerned with two things, first, what does the army have to procure; second, how is the production leading up to that procurement progressing?

It is necessary that as complete an understanding as possible of the difficulties of procurement be presented to the engineers in their effort to serve the government in any preparedness program. First of all it is essential that the rate of mobilization be in direct proportion to the function of procurement of essential commodities for the Army because it is always possible to mobilize men and train them faster than certain items necessary for their fighting efficiency can be manufactured and delivered to them. Procurement must therefore be accomplished with the maximum of speed and the minimum of waste. It is here that the necessity for detailed planning must be emphasized. Prior to the World War industrial planning was not given serious consideration either in our Armies or in our Industries from the war standpoint.

We are told that the Germans' threatened success in the war was due to a system which has been termed "Vertical Trusts." Such trusts are organizations that own their raw material and control within themselves all the economic processes until the finished products are delivered to markets. Obviously this type of organization is invaluable in war time and constitutes the greatest asset behind the line of battle. The problem resolves itself into our ability to assemble these vertical trusts from the integral parts of our industries and in order to do this, it is first necessary to know the potential value and power of the parts.

In reviewing the results obtained shortly after this country entered into the war, it appears improbable that any man or group of men, however able, could have brought order out of the chaos of our industrial situation. Nothing had been done regarding the industrial phase of preparedness in time of peace and no one could plan a war and fight it at the same time without tremendous losses.

We have been told by the War Department that it has taken fifty officers nine months to figure the requirements of the recently developed mobilization plan. Further it will take about five years to work out procurement plans in as complete detail as they are desired. The reason for this is clear when it is considered that branches like the Ordnance Department and Air Service make demands on industry for which no present facilities exist. It will require an industrial survey of a vast number of factories before an accurate estimate of war-time production can be made. Officials must not only survey these facilities but they must go carefully into the field of secondary requirements, such as machine tools, jigs, dies, gauges, etc. With the number of officers available, and with limited funds, this preliminary survey will take a long time. Breaking ground and laying a foundation is a slow and tedious task, but if well done, the other elements fall quickly into line and the superstructure can be readily altered for changing conditions.

The following list shows some of the most critical items of procurement which are of special interest to the engineer:

In the Quartermaster Corps: Uniforms, Hats, Leggins, Shoes, Wagons, Harness, etc.
In the Ordnance Department: Small arms, Small arms ammunition, Artillery, Artillery ammunition, Bombs, Gun mounts, etc.
In the Air Service: Aircraft engines, Airships.
In the Signal Corps: Radio equipment, and all items of communication.
In the Engineer Corps: Filling emergency demands from the Theatre of Operations.
In the Chemical Warfare Service: Gas masks, Gas, etc.

In developing the procurement program further, it is necessary to develop extensive organizations, allocate facilities, arrange for placing war orders on a fair and equitable basis, determine inspection methods and standards, lay plans for capital expenditures in fundamental industries, work out a suitable and equitable program for labor, develop sufficient power resources and arrange to administer transportation systems.

In this work the War Department has come to recognize the place of the engineer and the great public service which he can render. The present aim is to develop the peace time problem without thought of being either classed as a militarist or a pacifist, but simply looking to the great duty of national defense.

MEMOIR OF DECEASED MEMBER

THEODORE PARKER *

Theodore Parker, a member of the Boston Society of Civil Engineers, died in Atlantic, Quincy, Massachusetts, on June 14, 1923.

He was born in Quincy, April 2, 1858, and was the son of Chase and Lucinda (Tirrell) Parker. Mr. Parker's education was in the public schools of Quincy, and after graduating from the grammar school he entered the Dorchester High School and graduated in 1877. It must have been a severe test of a boy's desire for a thorough preparation to enter the Massachusetts Institute of Technology, — that journey every day, especially during the winter months, from Quincy to Boston.

Graduating with the class of '81 from the Institute, he immediately went west and was employed as engineer by the Chicago, Burlington and Quincy Railroad, — with headquarters at West Burlington, Iowa. After several years of important location and construction work he was promoted to Division Engineer, with headquarters at Ottumwa, Iowa. Coming east in 1892 at the time of the death of his father, who was Roadmaster of the Old Colony Railroad, Mr. Parker entered the City Engineer's Department of Boston. His first assignment was Engineer-in-Charge of Muddy River Improvement, between the City of Boston and the Town of Brookline. At the completion of this important work, covering a period of years, the various parks and parkways occupied his services. This work consisted of a multitude of various engineering projects, viz.: grading, roadways, drainage systems, architectural stone bridges, sea walls, etc. After ten or twelve years of this park work he was trans-

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* Memoir prepared by Patrick J. Malley.

ferred to the Bridge and Ferry Division. In this division he had charge of the most important bridge and grade crossing work. The Broadway, Cove Street (Atlantic Avenue Extension), Boylston Street, and various other bridges were under his supervision, also the abolition of the Dorchester Avenue and East Boston grade crossings.

For the past twelve years Mr. Parker was employed in the Highway Division, constructing the various forms of municipal street pavements. Many of the important street widenings and boulevards were constructed under his supervision.

In 1877 he married, in West Burlington, Iowa, Minnie M. Cook, who survives him, together with two daughters, Grace C. born in 1890 and Ruth W. (Mrs. Everett Pope) born in 1892. A sturdy grandson, Everett Parker Pope, four years old, was his almost constant companion the past few years. Mr. Parker was very musical and deeply religious. The church choir and success of the men's club connected with the church were his frequent thoughts. Building up the membership, assistance and encouragement to the Rector in all his endeavors were personal interests. Mr. Parker was Senior Warden of St. Chrysostom's Church, Wollaston.

Mr. Parker was a well-read and cultivated gentleman. Educated scientifically he possessed also a well-trained classical mind. One of his favorite quotations was the beautiful Latin prayer of Mary Queen of Scots.

In boyhood he was a great baseball pitcher. The Dorchester High School team was a winner when Parker was on the mound. His old team-mate catcher told the writer of the wonderful games and erstwhile scores in those early days of the seventies. In military drill young Parker was first Sergeant of the Prize Winning Company, Dorchester High School capturing the coveted honor in Old Boylston Hall. One can imagine in those early days the white silk flag going to an out-of-town school company. How proud the first Sergeant was with the trophy stuck in his gun barrel, won from the crack city high schools.

In everything he was thorough, earnest and wonderfully industrious. Nothing slighted, everything weighed and properly balanced. Broad visioned and a great lover of liberty, especially for smaller nations and peoples. A real American in thought and action. A great help and preceptor to the young engineer. Generous with his mature knowledge and experience.

In closing, this quotation, so often heard recited by Mr. Parker, appears most fitting:

Dies irae, dies illa
Solvet saeclum in favilla
Dies magna et amara
Valde, et vale, Alleluia.

Vol. X DECEMBER, 1923 No. 10

BOSTON SOCIETY OF CIVIL ENGINEERS

FOUNDED 1848

PROCEEDINGS

MINUTES OF MEETINGS

Sanitary Section

Boston, November 7, 1923. — A special meeting of the Sanitary Section of the Boston Society of Civil Engineers was held this evening in the library of the Society with the Chairman, John P. Wentworth, presiding.

It was announced that at a meeting of the Executive Committee Mr. F. W. Haley had been admitted to membership in the Section.

Prof. Charles M. Allen of the Worcester Polytechnic Institute gave an informal talk on the measurement of water in pipe lines by means of a salt velocity method, in which the velocity is determined by electrical means.

Following Professor Allen's talk, Mr. F. A. Marston presented some charts and discussed the measurement of the velocity of a natural stream with salt, using chemical titration for the determination of time.

Then a large number of members discussed the subject of measuring the flow of water by several different methods.

The attendance was 64.

Harrison P. Eddy, Jr., *Clerk.*

Designers Section

Boston, November 14, 1923. — The regular November meeting of the Designers Section of the Boston Society of Civil Engineers was called to order this evening at 6.15 p.m. by Chairman Walter W. Clifford.

The report of the October meeting was read and approved.

The Chairman introduced Mr. William W. Lewis, Assistant Engineer of the Boston Transit Department. Mr. Lewis gave a detailed talk on "Unusual Features in the Design of New Ferry Slips for the City of Boston."

Sketches were made on the blackboard and photographs and blue prints shown bringing out the details of the ferry slips very clearly.

A discussion followed the talk.

There were 25 members and visitors present.

The meeting adjourned at 7.53 P.M.

WALDO F. PIKE, *Clerk.*

APPLICATIONS FOR MEMBERSHIP

[December 15, 1923]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

For Admission

Crosby, Irving Ballard, Jamaica Plain, Mass. (Age 33, b. Roslindale. Mass.) Graduate of Massachusetts Institute of Technology and Harvard University, specializing at both institutions in geology. Has been connected with the proposed Benham Falls dam on the Deschutes River in Oregon; the proposed American Falls dam on Snake River, Idaho; Muscle Shoals dam on the Tennessee River; the Mitchell dam and two proposed dams on the Coosa River and one on the Tallapoosa River in Alabama, also the State Line dam on the Cheat River in West Virginia. At present a member of W. O. Crosby and Irving B. Crosby, Consulting Geologists. Refers to J. B. Babcock, B. Brewer, L. F. Cutter, H. E. Sawtell.

Emery, Carl Bartlett, Portland, Maine. (Age 32, b. Portland, Maine.) Has worked for the Commissioner of Public Works in Portland and in the engineering division of Massachusetts Department of Public Health. Now a student at Northeastern University. Refers to H. B. Alvord, A. O. Bradshaw, F. L. Flood, N. L. Hammond, J. W. Ingalls.

Josten, Walter R. L., Cambridge, Mass. (Age 25, b. Klemme, Iowa.) Graduate of Iowa State College with degree B.S. in architectural engineering, and Harvard graduate work in architecture and engineering, 1922 to date. Has had three summers' experience in highway and drainage work, two summers' field work and inspection of paving. At present assistant engineer with McLaughlin & Burr. Refers to J. B. Babcock, E. D. Mortenson.

Klein, Zoltan, Boston, Mass. (Age 31, b. Brexnobamya, Hungary.) Graduate in railroad engineering, State College of Hungary. Has worked three years with state railroads in Hungary as surveyor, in charge of work; two years as surveyor in engineering corps of Austro-Hungarian Army; eighteen months as engineering draftsman in New York City, six months as structural draftsman, and since September 1, 1923, as structural draftsman with Stone & Webster, Inc. Refers to H. P. Fessenden, H. A. Gray, C. E. Nichols, E. S. Parker.

Meserve, George Harris, Jr., Medford, Mass. (Age 21, b. Boston, Mass.) Graduate of Medford High School. Entered Northeastern University in January, 1922. During work periods has been employed by Whitman & Howard as transitman. Refers to H. B. Alvord, C. S. Ell, J. W. Ingalls, W. E. Nightingale.

O'Leary, Leo Thomas, Dorchester, Mass. (Age 30, b. South Boston, Mass.) Student at Northeastern University. Refers to H. B. Alvord, C. S. Ell, J. W. Ingalls, W. E. Nightingale.

Randlett, Norman Prescott, Boston, Mass. (Age 23, b. Laconia, N. H.) Attended University of New Hampshire, 1918–19; graduated from Massachusetts Institute of Technology in 1922 with degree of B.S. in architectural engineering. From October, 1922, to April, 1923, with Berlin Construction Company as detailer and designer of structural steel; April, 1923, to October, 1923, with Stone & Webster, Inc., as structural draftsman; from October, 1923, to present in charge of making charts with a Boston firm. Refers to S. K. Cohen, W. H. Lawrence, D. Peabody, Jr., H. Sutherland.

SHAPIRO, DAVID, Fall River, Mass. (Age 22, b. New York, N. Y.) Entered Northeastern University, Engineering School, September, 1921. During work periods has been employed in putting up steel frames for concrete work; on road construction as transitman and draftsman, and last summer as transitman on concrete construction. At present a student at Northeastern University. Refers to H. B. Alvord, C. S. Ell, J. W. Ingalls, W. E. Nightingale.

SIMPSON, EDWARD J., Dorchester, Mass. (Age 33, b. Boston, Mass.) Educated in Mechanic Arts High School, Franklin Union and Y. M. C. A. evening school, also two correspondence courses in structural design. Has had four years drafting, three years at designing, and four and a half years as engineer. Is at present employed by Jackson & Moreland. Refers to C. R. Berry, B. A. Bowman, E. H. Cameron, W. W. Clifford, W. D. Henderson, A. G. Martin.

SQUIER, ROGER WINTHROP, Boston, Mass. (Age 21, b. Winthrop, Mass.) Now a student of engineering at Northeastern University. Has been rodman with R. J. Farnham, inspector for United States Department of Agriculture in the middle West, transitman with Whitman & Howard, and draftsman with Massachusetts Public Works Department, Highway Division. Refers to H. B. Alvord, C. S. Ell, J. W. Ingalls, W. E. Nightingale.

SULLIVAN, BENJAMIN EUGENE, Quincy, Mass. (Age 21, b. Quincy, Mass.) Educated in the Quincy public schools and Fore River Drafting School. In 1921 he entered the employ of A. L. Smith Iron Works, where he is at present employed as a structural draftsman, and is attending evening school at Franklin Union. Refers to R. Abbott, O. D. Chiesa, H. A. Gray, E. D. Mortenson, A. O. Wilson.

WICKERSON, CLARENCE RODOLPH, Milton, Mass. (Age 21, b. Eastport, Maine.) Now a Junior at Northeastern University. During working periods has been employed by Whitman & Howard. Refers to H. B. Alvord, C. S. Ell, J. W. Ingalls, W. E. Nightingale.

WYNER, HENRY ISRAEL, Allerton, Mass. (Age 21, b. Boston, Mass.) Entered School of Engineering, Northeastern University, September, 1921. During summer of 1923 employed by Walter B. Foster, Hingham, as inspector and instrumentman on sidewalk construction, sewer construction and laying out grounds of the municipal building at Hull. Now a student at Northeastern University. Refers to H. B. Alvord, C. S. Ell, J. W. Ingalls, W. E. Nightingale.

LIST OF MEMBERS

Additions

Anthony, Sidney S.	50 Gloucester St., Boston, Mass.
Carchia, Michael A.	308 Bellevue St., West Roxbury, Mass.
Connor, Wilbert H.	45 Bayswater St., East Boston, Mass.
Hooper, Olcott L.	Room 1–336, Mass. Inst. Tech., Cambridge, Mass.
Houser, George C.	199 Marlborough St., Boston, Mass.
Stearns, Elton O.	159 Chestnut St., Waltham, Mass.

Changes of Address

Carter, Clarence E.	21 Hanscom Ave., Reading, Mass.
Dearborn, Elmore L.	27 Brook St., Brookline, Mass.
Fletcher, Austin B.	Cosmos Club, Washington, D. C.
Flett, Louis E.	10 Almont St., Medford, Mass.
Rankin, Elmer P.	4 Highland Ave., South Braintree, Mass.
Rich, B. A.	36 Tyler St., Atlantic, Mass.
Steward, Douglas P.	811 Grove Ave., Johnstown, Pa.
Steward, H. M.	31 St. James Ave., Boston, Mass.
Wade, W. Newell	128 Glenville Ave., Suite 3, Allston, Mass.
Watson, George N.	37 Robbins Rd., Watertown, Mass.
Winsor, Frank E.	143 Adelaide Ave., Providence, R. I.

Death

Miller, Hiram Allen	November 2, 1923

LIBRARY NOTES

Book Review

"Movable and Long-Span Steel Bridges," Editors-in-chief, George A. Hool, S.B., Consulting Engineer, Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, B.S., Professor of Structural Engineering, University of Wisconsin. McGraw-Hill Book Co., Inc., New York; 1923. 496 pp.

Reviewed by Bion A. Bowman

This book is one of a series of six books written, or to be written, by men of large knowledge and experience. They are intended to provide the engineer and student with reference works covering the design and construction of the principal types of structures met with in the study and practice of modern civil engineering. The titles of the six volumes comprising this series are as follows:

Foundations, Abutments and Footings
Structural Members and Connections
Movable and Long-Span Steel Bridges
Stresses in Framed Structures
Steel and Timber Structures
Reinforced Concrete and Masonry Structures

"Movable and Long-Span Steel Bridges" is the third book of the series to be published. The first two books of the series listed above were published in the Spring of this year.

This book has 488 pages embodying the following sections:

Section 1 — Bascule Bridges
Section 2 — Vertical Lift Bridges
Section 3 — Swing Bridges
Section 4 — Continuous Bridges
Section 5 — Cantilever Bridges
Section 6 — Suspension Bridges
Section 7 — Steel Arch Bridges
Section 8 — Analysis of Three-hinged Arch Bridges
Section 9 — Analysis of Fixed Arches
Section 10 — Analysis of Two-hinged Arches

The Editors-in-Chief are: George A. Hool and W. S. Kinne, Professors of Structural Engineering, University of Wisconsin. Assisted by the following list of contributors:

Chas. A. Ellis, Vice-President, Strauss Bascule Bridge Co.
Phil A. Franklin, Structural Engineer, McClintic Marshall Co.
Arthur G. Hayden, Senior Assistant Engineer, Bronx Parkway Commission, New York. (Formerly designing engineer for the New York State Barge Canal.)
C. B. McCullough, Bridge Engineer, Oregon State Highway Commission.
H. E. Pulver, Associate Professor of Civil and Structural Engineering, The University of Wisconsin.
D. B. Steinman, Consulting Engineer, New York City.

Sections 1, 2 and 3 are devoted to movable bridges, a most complete treatment of the theory and design of bascule bridges being given, together with a much simplified and shortened method for determining the stresses in swing bridges.

Section 4 covers a discussion of the design and erection of continuous bridges; and clearly points out their advantages from an economic standpoint. In it are cited several notable examples which have served to establish the continuous truss as an important type in American bridge practice.

Section 5 is devoted to a brief treatment of cantilever bridges explaining the theory of design and the advantages of this type of bridge.

Section 6 is devoted to the subject of suspension bridges. In this section the theory of suspension bridges is clearly outlined and practical working methods of design thoroughly explained.

Sections 7, 8, 9 and 10 are devoted to the subject of steel arch bridges, 129 pages being devoted to this important type of bridge. The presentation of the theory of arch analysis is simply explained and numerous practical examples of its application are fully given.

"Movable and Long-Span Steel Bridges" should prove of great value to the bridge engineer who is engaged directly or indirectly in the design and building of steel bridges, and to the student who wishes to prepare himself for work in this field.

RECENT ADDITIONS TO THE LIBRARY

U. S. Government Reports.

Ports of Mobile, Ala., and Pensacola, Fla. By Corps of Engrs., U. S. A. and U. S. Shipping Board.

Report of Bureau of Civil Service to Governor-General of Philippine Islands, 1922.

State Reports.

Massachusetts. Industrial Review, July, 1923.
Massachusetts. Statistics of Labor. 1922.
New York. Report of Transit Commission. 1921.

Municipal Reports.

Newton, Mass. Annual Report of Street Commission. 1922.

New York, N. Y. Annual Report Board of Water Supply. 1922.

Miscellaneous.

Census of Republic of Cuba. 1919. Census National Bd.
Mining Catalogue. Metal-Quarry Edition. 1923.

Stresses in Framed Structures. Hool & Kinne. Gift of McGraw-Hill Book Co., Inc.

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